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## Deployment of Agriculture 4.0 with the Integration of IoT

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## Abstract

Agriculture is the primitive and crucial occupation for the people. Smart Agriculture (SA) is an emerging concept, because IOT sensors are capable of providing information about agriculture fields and then act upon based on the user input. Urbanization, which indirectly affected the lives of people in the agricultural sector by increasing level of environmental pollution, climate change, degradation of soil and water quality, increasing population, decreasing income from the farming industry, etc. In this Paper, it is proposed to develop a SA System that uses advantages of cutting-edge technologies such as Arduino, IOT and Wireless Sensor Network (WSN). Internet of Things (IoT)-based smart sensors is the new technique for the SA system. IoT-based SA system consists of various sensor nodes placed in different locations, internet service, smart remote devices, or computer systems with the internet that monitor the operation of sensor nodes, Wi-Fi, a camera with a microcontroller, and different interfacing sensing nodes for service. The system has a duplex communication link based on a cellular-Internet interface that allows for data inspection and irrigation scheduling to be programmed through an android application.

**Keywords:** Smart agriculture, Smart farming presence sensor, Agriculture 4.0, Digital agriculture.

## 1 | Introduction

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The agriculture sector is an essential sector of an economy for food security. According to India Brand Equity Foundation (IBEF), 58% of the people living in rural areas in India are dependent on agriculture [1]. Agriculture is the primitive and crucial occupation for the people of India, about 70% of the Indian population depends upon agriculture for their livelihood, and it contributes around 16% of Indian GDP [2]. Come as a new challenge and makes mass migration of rural people to the cities, emission of Greenhouse Gas (GHG), uses of fertilizers, water drainage system scarcity and production of agri-waste [3]. Agriculture produces food by using different resources like nutrients, soil, and water. To overcome these problems, optimization of agricultural productivity is essential to meet the growing world population demand [4]. The usage of water especially the fresh water resource by agriculture will be enormous and according to the current market surveys it is estimated that agriculture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant because of population growth and increased food demand [5].

Smart Agriculture (SA) is the new method mainly focusing on farming practices that increase productivity, security, and management and changing in input resources while reducing GHG emissions [6]. Sustainable agriculture provides the perfect solution for balancing agricultural production and environmental degradation. Smart farming provides smart technologies for SA to improve and optimize agrarian activities like increasing yields, promoting climate change, and supporting low emission from the agricultural sector, increasing the overall quality and quantity of farm products [7]. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones [8]. One of the existing systems uses thermal imaging to monitor the plant water status and irrigation scheduling. IOT based SA gives information about irrigation and has services like smart control [9].

IoT based smart sensors are the new trending technique for the intelligent agriculture system. It is mostly used in linking devices and assembles information [10]. IoT enabled sensor networks and cloud computing help in the transmission of data in real-time among different destinations. It performs monitoring, prediction, decision planning, and making decisions [11]. IoT based network consists of physical objects where sensors collected and transfer the real-time [12]. IoT technique has been in use in different fields like health care, agro-industries, ecological monitoring, traffic monitoring, restaurants food management system, military applications, smart cities, waste management, transportation, SA, home automation, smart meeting, smart environment, smart water, security and emergency, and many more [13].

## 2 | Literature Review

The development of a SA system using sensors, microcontroller within an IOT system is presented. The aim of the implementation is to demonstrate the smart and intelligent capabilities of the microcontroller to allow the decisions to be taken on watering the plants based on the continuous monitoring of the environmental conditions in the field [14]. It also aims at a predefined irrigation schedule as per the farmers' convenience, uploaded into the application developed for the same [15]. The implementation is a photovoltaic powered automated irrigation system that consists of a distributed wireless network of soil moisture and temperature sensors deployed in plant root zones [16]. These sensors continuously monitor the parameters and send it to the Arduino board for further processing which acts as an IOT gateway [17]. As per the survey conducted by Unites Nations- Food and Agriculture Organization states that as the population size is increasing, the demands of food will also increasing so by 2050 [18]. To overcome this issue, worldwide food production becomes essential to be increased by 70%. This is linked to the declining natural deposits, agricultural site area, changing weather situations making food safety a very significant area of discussion for most countries [19].

### Benefits of SA

- I. Improving crop production: This can be done by proper water, pesticide, correct planting and harvesting which will in turn increase the productivity [20].
- II. Water conservation: Correct application water by analyzing the requirement by using soil moisture and weather prediction sensors [21].
- III. Real-Time Data and Production Insight: With the IoT farmers can monitor the level of production, moisture in the soil, intensity of sunlight to make decision remotely [22].
- IV. Lowered Operation Costs: The reduction in cost, effective consumption of resources and human error can be achieved by automating the process [23].
- V. Increased Quality of Production: Farmers can understand the process by analyzing the quality and adjust the treatment to increase the quality.

The cloud in our system will include logic. The database will maintain the data received from the IOT gateway. The decision logic then decides whether the farmer action is needed to water the plants [20]. For example, in the developed system a threshold for temperature is kept at 25°C. whenever the temperature goes above the threshold temperature, the database will trigger an action to the decision logic which then sends a notification to the developed Smart Farming Android application [21]. The farmer will also get

notified by a SMS to his registered mobile phone. Based on the farmers action whether to turn ON/OFF the watering, a signal will be sent to the cloud and from the cloud to the gateway which will then send a signal to trigger the relay and turn on the water pump [22].

### 3 | Proposed Work

#### 3.1 | Internet of Things (IoT) to Agriculture

Combining the traditional way of farming with upcoming future technologies such as the IoT and Wireless Sensor Networks (WSN) can help in the westernization of agriculture at a lower cost [23]. WSN assembles the information from discrete classes of smart sensors and transmits that information to the central server using various wireless protocols. IoT application in agriculture will empower the framers with decision making on devices and automatic technology which will combine product knowledge and services for excellent farm productivity, profit and quality management. However, IoT system contains few challenges also such as security, privacy, and business model ownership solution and data governance. WSN is a kind of network that contains Radio Frequency (RF) transceivers, smart sensors, microcontrollers and biasing source. The arrival of IoT technology makes a switch from the use of WSN to IoT as the principal technique to shift agriculture to SA.

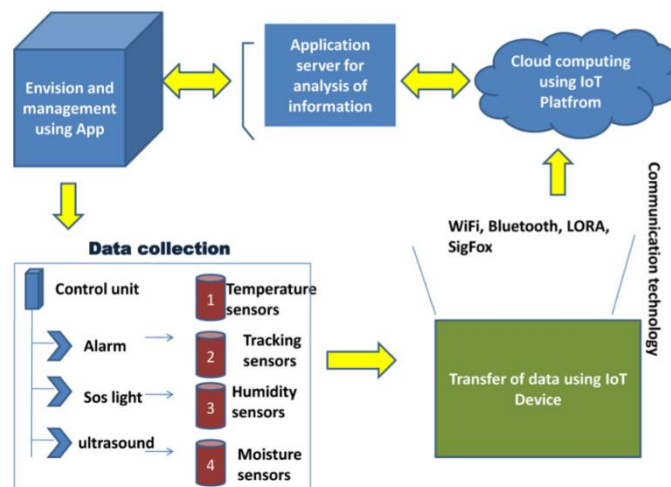


Fig. 1. IOT architecture for agriculture.

### 4 | Conclusion

IoT based SA system can prove to be very helpful for farmers since over as well as less irrigation is not good for agriculture. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. The system also senses the invasion of animals which is a primary reason for reduction in crops. This system generates irrigation schedule based on the sensed real time data from field and data from the weather repository. This system can recommend farmer whether or not, is there a need for irrigation. Continuous internet connectivity is required. This can be overcome by extending the system to send suggestion via SMS to the farmer directly on his mobile using GSM module instead of mobile app.

The environmental parameters and climatic condition changes based on the location and time which has direct impact on crop production in the field of agriculture which makes the decision making difficult for farmers. The IoT technologies leads to great benefits to the farmer's and also improved the crop production rate and reduction in cost. The different data acquisition sensors and their usage in the field of agriculture are discussed. The new technologies in the field of IoT along with the WSN have given a great impact in the field of agriculture. The integration of these with AI and other data mining methods



will lead to creation, innovation and implementation of new ideas for efficient production and marketing.

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